



US009162615B2

(12) **United States Patent**  
**Dippold et al.**

(10) **Patent No.:** **US 9,162,615 B2**  
(45) **Date of Patent:** **Oct. 20, 2015**

(54) **DIRECTION INDICATOR CIRCUIT FOR CONTROLLING A DIRECTION INDICATOR IN A VEHICLE**

(56) **References Cited**

U.S. PATENT DOCUMENTS

(71) Applicant: **Infineon Technologies AG**, Neubiberg (DE)

4,291,302	A	9/1981	King et al.	
4,683,416	A *	7/1987	Bynum	323/314
5,061,863	A *	10/1991	Mori et al.	327/50
5,247,280	A *	9/1993	Brooks	340/458
5,444,595	A *	8/1995	Ishikawa et al.	361/86
5,910,737	A *	6/1999	Kesler	327/89
6,466,081	B1 *	10/2002	Eker	327/541
6,700,432	B2	3/2004	Misdorn et al.	

(72) Inventors: **Gebhart Dippold**, Finkenstein (AT); **Robert Illing**, Villach (AT); **Alexander Mayer**, Treffen (AT); **Albino Pidutti**, Martignacco (IT)

FOREIGN PATENT DOCUMENTS

(73) Assignee: **INFINEON TECHNOLOGIES AG**, Neubiberg (DE)

DE	2425410	A1	11/1975
DE	2507005	A1	9/1976
DE	4224586	A1	1/1994
DE	60129778	T2	6/2008
GB	1463466	A	2/1977

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

OTHER PUBLICATIONS

(21) Appl. No.: **14/034,604**

English abstract of DE 4224586 A1 dated Jan. 27, 1994.

(22) Filed: **Sep. 24, 2013**

\* cited by examiner

(65) **Prior Publication Data**

US 2014/0085074 A1 Mar. 27, 2014

Primary Examiner — Brent Swarthout

(30) **Foreign Application Priority Data**

Sep. 25, 2012 (DE) ..... 10 2012 018 927

(57) **ABSTRACT**

(51) **Int. Cl.**

**B60Q 1/34** (2006.01)

**B60Q 1/38** (2006.01)

(52) **U.S. Cl.**

CPC . **B60Q 1/34** (2013.01); **B60Q 1/382** (2013.01)

(58) **Field of Classification Search**

CPC ..... **B60Q 1/34**

USPC ..... 340/463, 468, 475; 315/77, 287;

327/419; 361/78, 79, 86; 323/282

See application file for complete search history.

A direction indicator circuit for controlling a direction indicator may include: a first terminal for connecting to a supply voltage terminal; a second terminal for connecting to a direction indicator switch and a lighting means; a third terminal for connecting to a capacitor; wherein the direction indicator circuit is designed to provide the lighting means with a current during an on state and with no current during an off state, wherein the duration of the on state and the duration of the off state are determined by a voltage at the capacitor; wherein the direction indicator circuit has a first and a second circuit, wherein the capacitor provides the supply voltage for the first and second circuits during the on state; wherein the current which flows through the first circuit has a negative temperature coefficient, and the current which flows through the second circuit has a positive temperature coefficient.

**4 Claims, 7 Drawing Sheets**

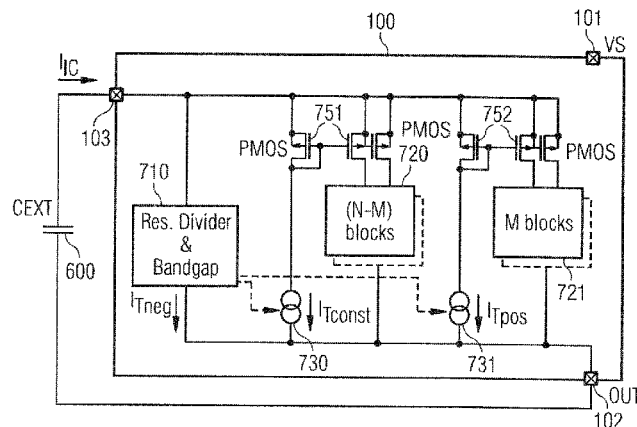


FIG 1

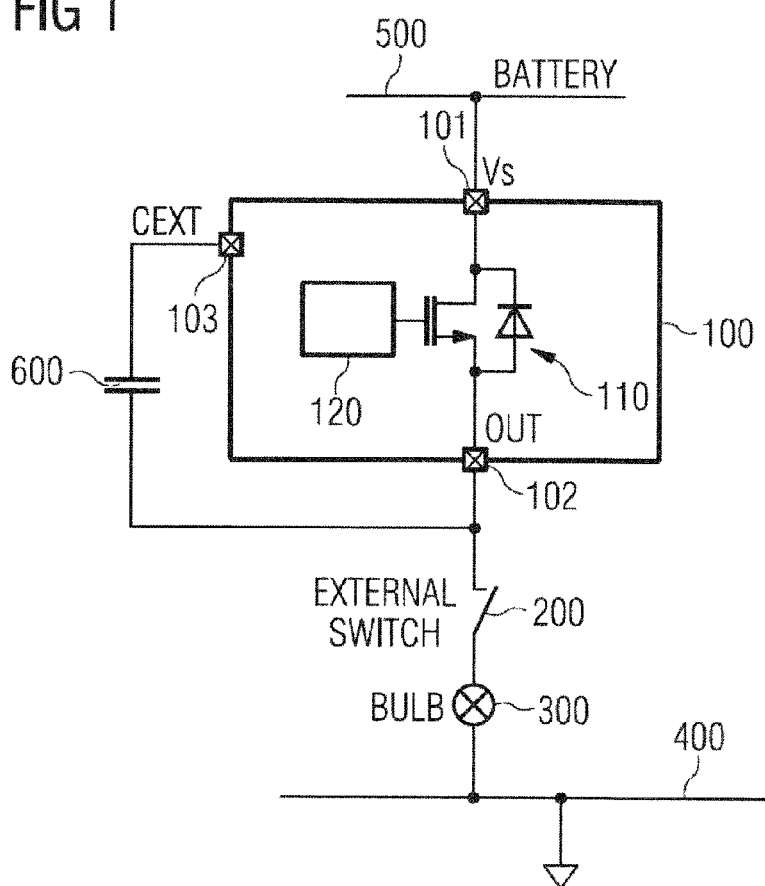


FIG 2

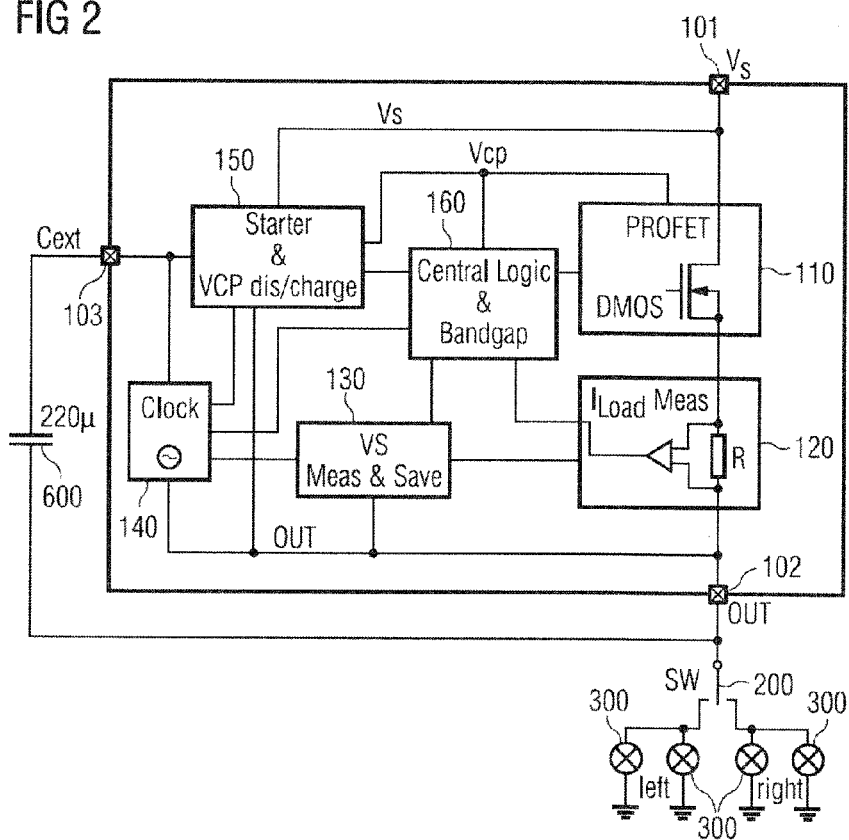


FIG 3

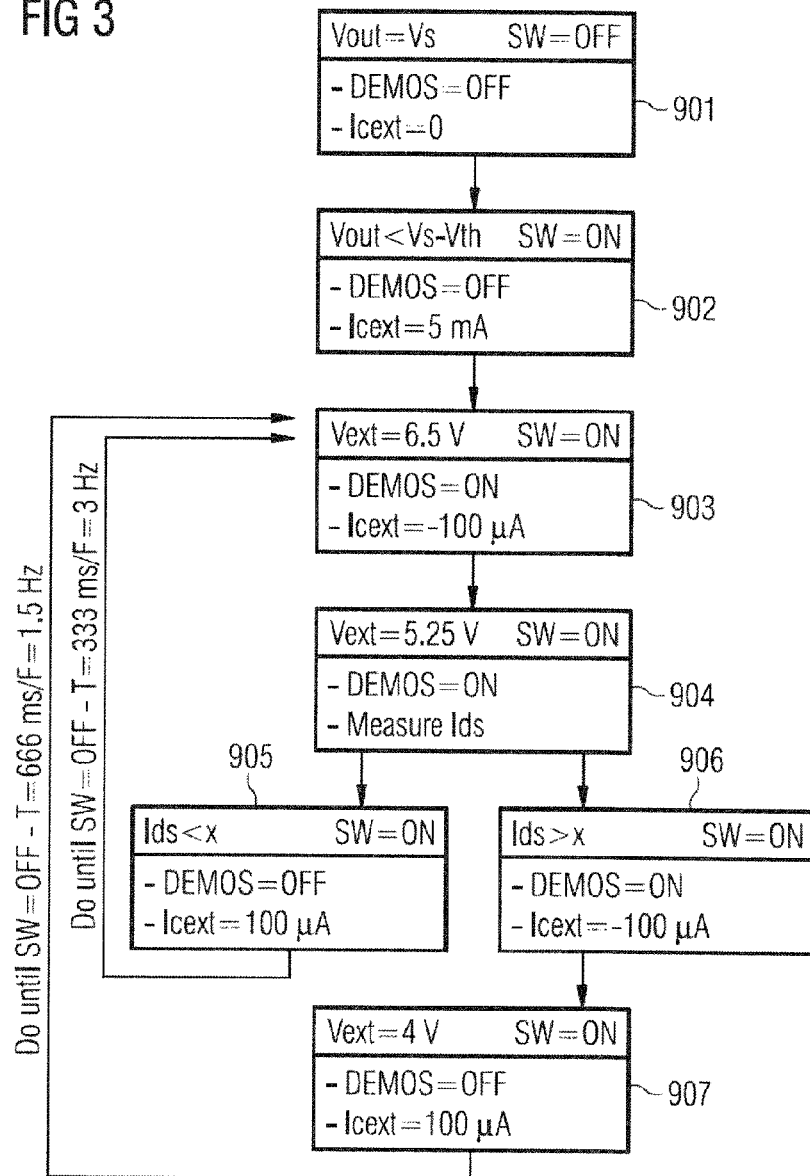


FIG 4

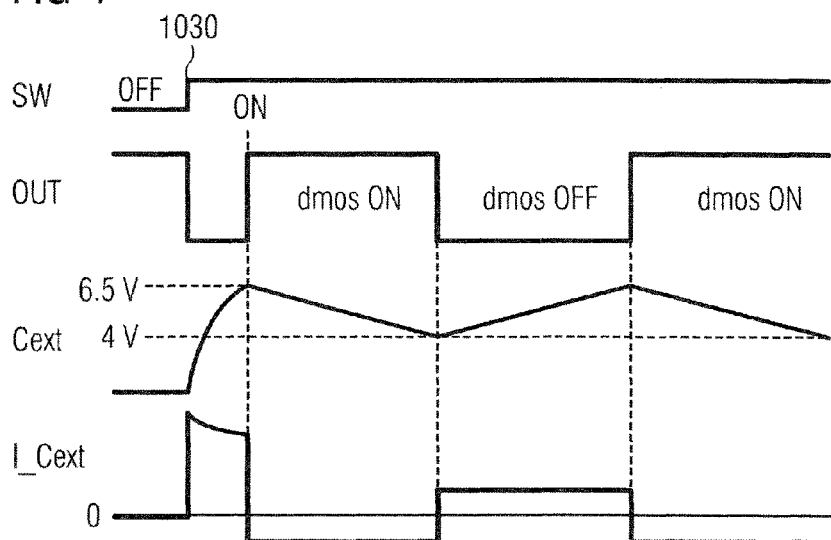


FIG 5

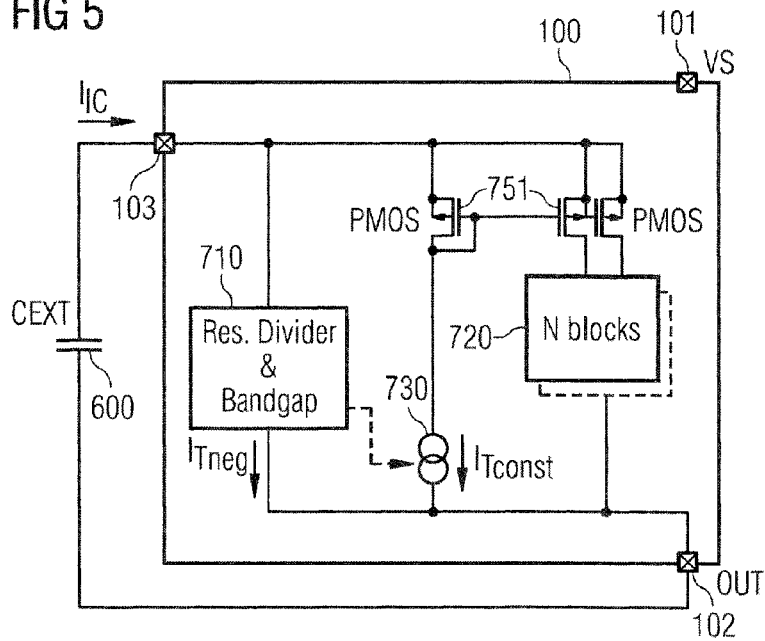


FIG 6

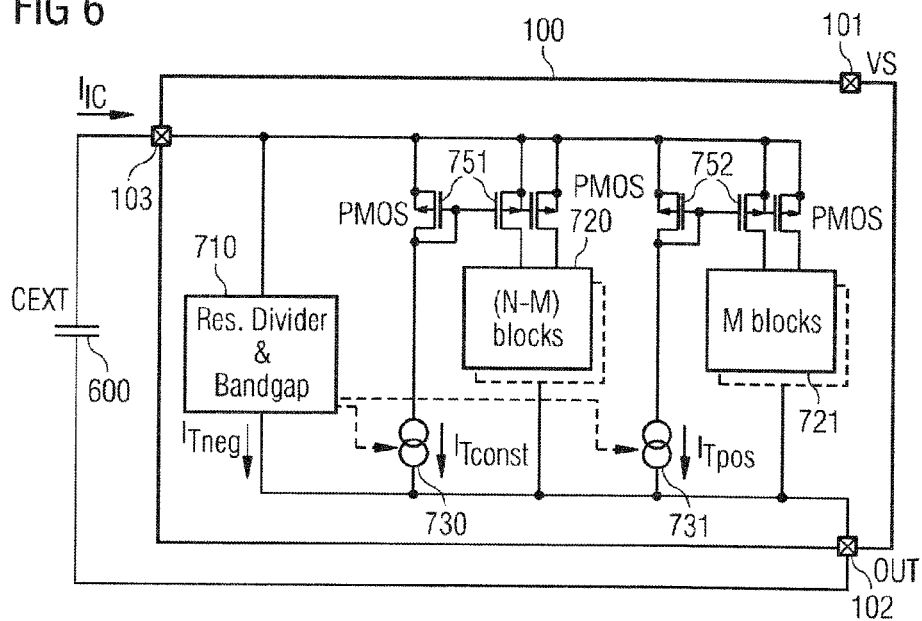


FIG 7

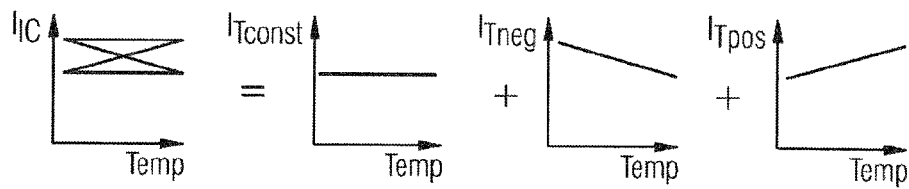


FIG 8

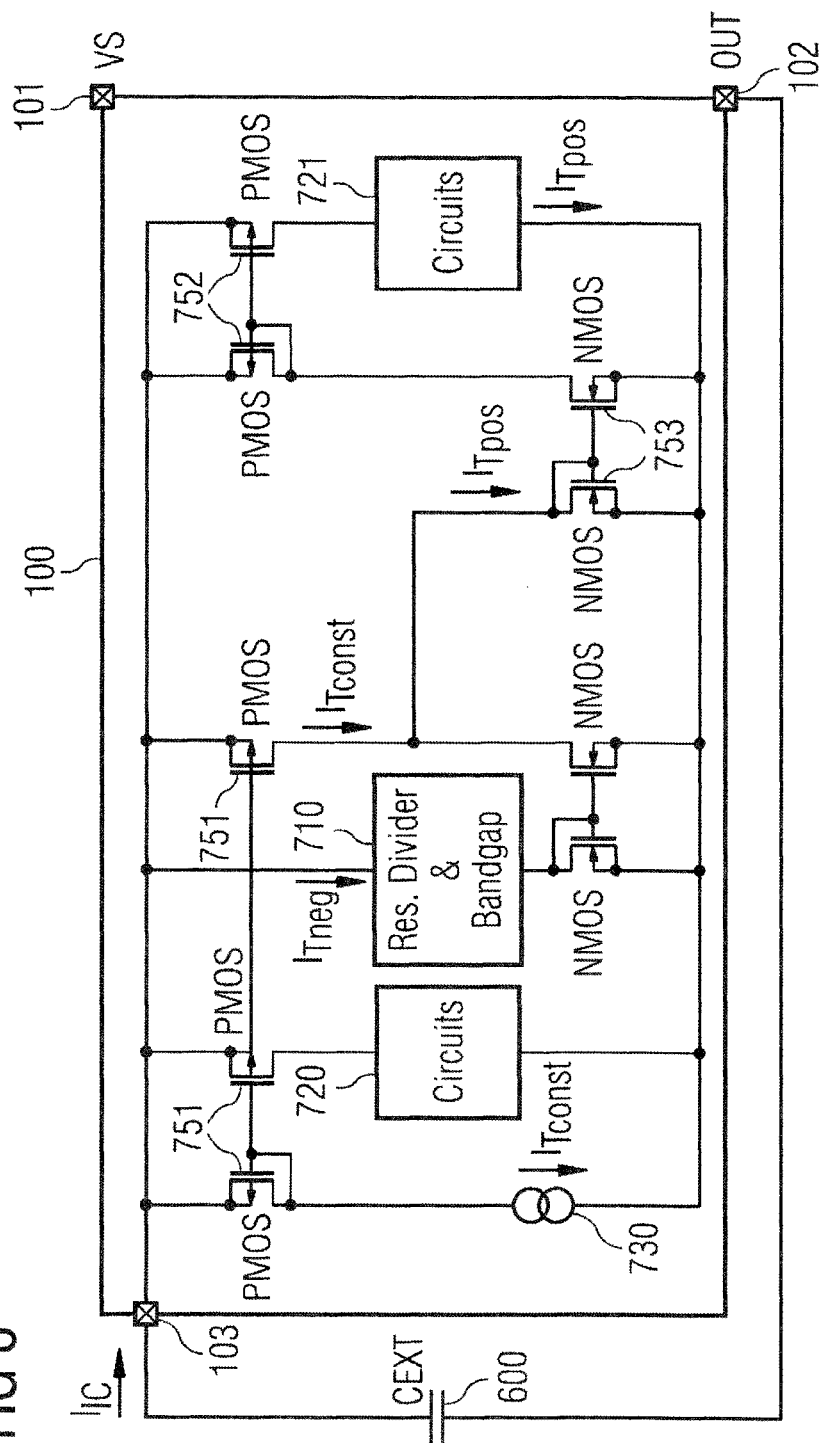


FIG 9

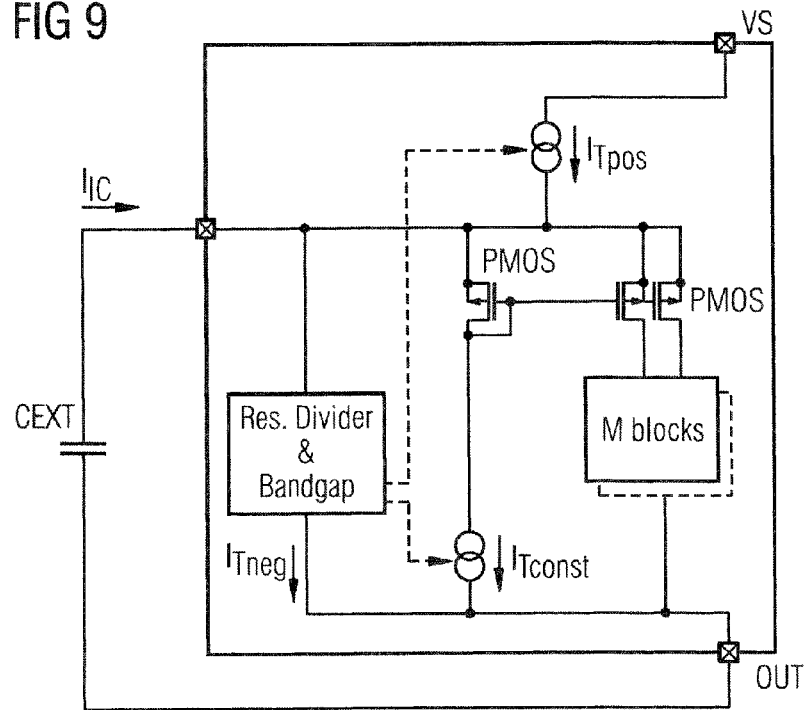
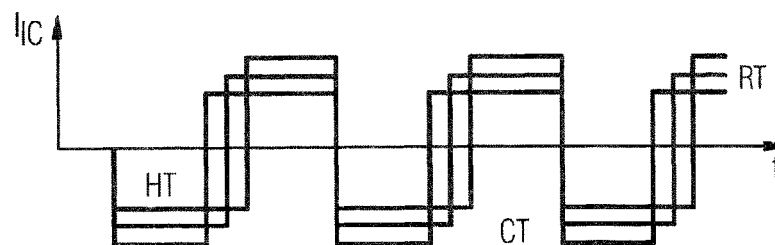


FIG 10





1

# **DIRECTION INDICATOR CIRCUIT FOR CONTROLLING A DIRECTION INDICATOR IN A VEHICLE**

## **CROSS-REFERENCE TO RELATED APPLICATION**

This application claims priority to German Patent Application Serial No. 1020120189273, which was filed Sep. 25, 2012, and is incorporated herein by reference in its entirety.

## **TECHNICAL FIELD**

Various embodiments relate to a direction indicator circuit for actuating a direction indicator in a vehicle.

## **BACKGROUND**

Indicators for the direction of travel, referred to as direction indicators, are required for applications in vehicles. A direction indicator has the function of using a lighting means to indicate to other road users if the road user wishes to change the direction of travel. Direction indicators have been implemented electromechanically, efforts being made to replace these electromechanical solutions by more economical electronic ones. A contemporary direction indicator is composed of a direction indicator circuit, a direction indicator switch and a plurality of lighting means, for example incandescent lamps. Since an electronic solution is intended to replace an established electromechanical solution, value is placed on a direction indicator circuit which is as economical as possible and on an overall solution which is as economical as possible. The direction indicator circuit, the direction indicator switch and the lighting means are connected in series between the supply voltage and the vehicle ground or a ground terminal of the vehicle. If the direction indicator switch is closed, the lighting means is to flash with a defined frequency, that is to say light up or not light up periodically. The frequency is defined as 1.5 Hz or 3 Hz, wherein the frequency of 3 Hz indicates a fault in a lighting means.

Direction indicator circuits in vehicles are used in environments which are very demanding in terms of the robustness and the reliability of the direction indicator circuit and the direction indicator per se. Direction indicators are subject to low and high temperatures, a high degree of humidity, to soiling and dirt of all types and to electromagnetic emissions. For an electronic circuit it is advantageous if, on the one hand, it is robust with respect to these stresses and, on the other hand, does not generate any stresses for other circuits. If an electronic circuit generates such stress, for example as a result of generating a large amount of heat or, for example, due to high electromagnetic emissions, then a high level of expenditure has to be made during operation to minimize this stress again at a different design level. A circuit which only has low electromagnetic emission has a high cost advantage for the user since the user can, for example, dispense with expensive filters. A further cost advantage can be achieved in that components are generally replaced by more cost-effective and robust components. At present, capacitors which are larger than 200  $\mu$ F are used to supply direction indicator circuits. If the power consumption of the direction indicator circuit is reduced, a smaller and therefore more cost-effective capacitor can be used.

## **SUMMARY**

A direction indicator circuit for controlling a direction indicator may include: a first terminal for connecting to a

2

supply voltage terminal; a second terminal for connecting to a direction indicator switch and a lighting means; a third terminal for connecting to a capacitor; wherein the direction indicator circuit is designed to provide the lighting means with a current during an on state and with no current during an off state, wherein the duration of the on state and the duration of the off state are determined by a voltage at the capacitor; wherein the direction indicator circuit has a first and a second circuit, wherein the capacitor provides the supply voltage for the first and second circuits during the on state; wherein the current which flows through the first circuit has a negative temperature coefficient, and the current which flows through the second circuit has a positive temperature coefficient.

## **BRIEF DESCRIPTION OF THE DRAWINGS**

In the drawings, like reference characters generally refer to the same parts throughout the different views. The drawings are not necessarily to scale, emphasis instead generally being placed upon illustrating the principles of the invention. In the following description, various embodiments of the invention are described with reference to the following drawings, in which:

FIG. 1 shows a direction indicator with a direction indicator circuit;

FIG. 2 shows a direction indicator with a direction indicator circuit;

FIG. 3 shows a flow chart relating to the sequence in a direction indicator circuit;

FIG. 4 shows signal profiles;

FIG. 5 shows a direction indicator circuit;

FIG. 6 shows an embodiment of a direction indicator circuit; FIG. 7 shows signal profiles plotted against the temperature;

FIG. 8 shows a further embodiment of a direction indicator circuit;

FIG. 9 shows a further embodiment of a direction indicator circuit; and

FIG. 10 shows signal profiles.

## **DESCRIPTION**

The following detailed description refers to the accompanying drawings that show, by way of illustration, specific details and embodiments in which the invention may be practiced.

The word “exemplary” is used herein to mean “serving as an example, instance, or illustration”. Any embodiment or design described herein as “exemplary” is not necessarily to be construed as preferred or advantageous over other embodiments or designs.

The word “over” used with regards to a deposited material formed “over” a side or surface, may be used herein to mean that the deposited material may be formed “directly on”, e.g. in direct contact with, the implied side or surface. The word “over” used with regards to a deposited material formed “over” a side or surface, may be used herein to mean that the deposited material may be formed “indirectly on” the implied side or surface with one or more additional layers being arranged between the implied side or surface and the deposited material.

FIG. 1 shows a direction indicator with a direction indicator circuit 100, a direction indicator switch 200 and a lighting means 300 of a direction indicator. The direction indicator circuit 100 is connected by a first terminal 101 to a supply voltage 500. A second terminal 102 of the direction indicator circuit is connected to the direction indicator switch 200. The

3

direction indicator switch **200** is connected to the lighting means **300**. The arrangement of the direction indicator switch **200** and of the lighting means **300** can be interchanged. A capacitor **600** is connected to the third terminal **103** of the direction indicator circuit **100**. In this arrangement, the direction indicator circuit **100** replaces electromagnetic components. Owing to the conservative development of the vehicle industry it is often necessary for the electronic components which are intended to replace the electromechanical or mechanical components to comply with the specifications of the original components.

If the direction indicator switch **200** is off, i.e. open, and if the arrangement is in equilibrium, that is to say the direction indicator circuit has already been open for a long time, no current can flow through the arrangement. Since no current flows through this arrangement, the direction indicator circuit is also currentless, i.e. there is no supply voltage present at the direction indicator circuit. The lighting means **300** does not light up. In this state the total supply voltage is present at the direction indicator switch **200**. The supply voltage is present between the supply voltage terminal **500** and a ground terminal **400**. The supply voltage can be provided, for example, by a battery or a generator. The direction indicator switch **200** can be mounted, for example, on a dashboard of an automobile or on a handlebar of a motor cycle. Instead of a lighting means **300**, a plurality of lighting means can also be used. The direction indicator switch **200** can be a multi-path switch which enables a direction indication.

If the direction indicator switch **200** is closed, a current can flow through the direction indicator circuit **100** and through the lighting means **300**. In this starting phase, this current flows through the direction indicator circuit **100**, wherein the direction indicator circuit **100** diverts this current, which flows into the first terminal **101**, to the third terminal **103**, with the result that the capacitor **600** is charged. The current is so high that the capacitor **600** is charged in an appropriate time, and so low that the lighting means **300** does not light up. During this starting phase in which the voltage at the capacitor rises, all the circuit components of a control circuit **120** of the direction indicator circuit **100** begin to operate. After all the circuit components of the control circuit **120** have begun to operate and the voltage at the capacitor **600** exceeds an upper threshold, the direction indicator circuit ends the starting phase and goes into an on state. The starting phase should be terminated within 50 ms.

The direction indicator circuit **100** has a switch **110**. This switch **110** may be embodied, for example, as a high side switch, wherein this high side switch may be embodied as an NMOS. The switch **110** may, for example, also be embodied as a switch **110** using GaN technology or SiC technology. If the direction indicator arrangement is symmetrical along the horizontal line, or the supply voltage terminal **500** and the ground terminal **400** are interchanged, the switch **110** may also be embodied as a low side switch. The switch **110** may be embodied as a PMOS using a fourth terminal.

During the on state, the switch **110** is closed. Since both the switch **110** and the direction indicator switch **200** are then closed, the entire voltage drops across the lighting means **300**, with the result that the lighting means **300** lights up. The voltage at the third terminal is, with respect to the ground terminal **400**, in the on state above the voltage at the first terminal. That is to say the direction indicator circuit **100** is supplied using the capacitor **600**. The capacitor **600** is thereby discharged. If the voltage at the capacitor **600** drops below a lower threshold, the direction indicator circuit ends the on state and goes into the off state.

4

During the off state, the switch **110** is open. Since the switch **110** is then open but the direction indicator switch **200** is closed, the entire voltage drops across the direction indicator switch **200**, with the result that the lighting means **300** does not light up. The voltage at the third terminal is, with respect to the ground terminal **400**, in the off state below the voltage at the first terminal. This means that the direction indicator circuit **100** can charge the capacitor **600**. If the voltage at the capacitor exceeds the upper threshold, the direction indicator circuit ends the off state and goes into the on state.

FIG. 2 shows a detailed embodiment of the direction indicator circuit. The direction indicator circuit has a measuring circuit **120** which is designed to measure the current through the switch **110**. The direction indicator circuit **100** has an evaluation and storage circuit **130** which is designed to evaluate and/or store measured values. The direction indicator circuit **100** has a clock generator **140** which is designed to generate a clock. The direction indicator circuit **100** has a logic circuit **160** which is designed to provide a bandgap voltage, to provide a reference current and to provide a logic which administers the on state, the off state and the starting phase. The direction indicator circuit has a supply circuit **150** which is designed to charge the capacitor **600** during the starting phase, discharge the capacitor during the on state, charge the capacitor during the off state, provide at least one supply voltage for the measuring circuit **120**, the evaluation and storage circuit **130**, the clock generator **140** and the logic circuit **160**, and to provide at least one bias current for at least one of the measurement circuit **120**, the evaluation and storage circuit **130**, the clock generator **140** and the logic circuit **160**.

FIG. 3 shows a flow chart of the sequence in a direction indicator circuit **100**. In a first state **901**, the direction indicator switch **200**, SW, is off. The switch of the direction indicator circuit **110**, DMOS, is off. No current flows into the capacitor **600**. In a second state **902**, the direction indicator switch **200** SW is closed, i.e. on. The capacitor **600** is charged with a current of 5 mA. In a third state **903**, the direction indicator switch **200**, SW is closed, i.e. on. If the capacitor voltage reaches an upper threshold of, for example 6.5V, the switch **110**, DMOS is closed, or switched on. Since the greater part of the voltage of the supply voltage terminal **500** now drops across the lighting means **300**, the voltage at the third terminal is higher than the voltage at the supply voltage terminal **500**. The direction indicator circuit **100** is then supplied with voltage by the capacitor **600**. In order to supply the direction indicator circuit **100**, a discharge current 100  $\mu$ A is extracted from the capacitor **600**, i.e. the capacitor is discharged. This discharge current must be set precisely since the duration of the on state is determined by means of this current and a further threshold which will be explained below. The duration of the on state is defined by the size of the capacitor **600**, the magnitude of the discharge current and the magnitude of the further threshold. In a fourth state **904**, the direction indicator switch **200**, SW is closed, i.e. on. If the capacitor voltage reaches a first lower threshold of, for example, 5.25 V, the current of the switch **110** is checked. If the current of the switch **110** DMOS is lower than a first current threshold, the direction indicator circuit **100** changes into the off state or into a fifth state **905**. In this fifth state **905**, the switch **110**, DMOS is opened or off. The capacitor is charged with a current of 100  $\mu$ A. If the voltage at the capacitor **600** reaches the upper threshold again, the direction indicator circuit **100** goes into the third state **903** again. The fifth state **905** can be reached, for example, if one of at least two lighting means **300** is defective, with the result that a current

5

flows which is lower than an expected current. In this case, the direction indicator will flash with a higher frequency in order to indicate to a user that a defect is present. If the current of the switch **110** DMOS is larger during the fourth state **904** than a first current threshold, the direction indicator circuit changes into a sixth state **906**. In this sixth state **906**, the switch **110** DMOS is closed, i.e. on. The capacitor is discharged with a current of  $100\ \mu\text{A}$ . A seventh state is reached if the capacitor voltage reaches a second lower threshold of, for example,  $4\ \text{V}$ . In this seventh state **907**, the switch **110** DMOS is closed, or on. The capacitor is discharged with a current of  $100\ \mu\text{A}$ . If the voltage at the capacitor **600** reaches the upper threshold again, the direction indicator circuit **100** goes into the third state **903** again. The seventh state **907** can be reached, for example, if none of at least one lighting means **300** is defective, with the result that a current flows which is as high as an expected current. In this case, the direction indicator is to flash with a normal frequency in order to indicate to a user that there is no defect.

The values of the thresholds are only exemplary values which may vary from one direction indicator circuit **100** to another direction indicator circuit **100**. A change in the manufacturing technology of the direction indicator circuit **100** can lead to adaptation of these thresholds.

FIG. 4 shows signal profiles. The first signal from the top shows the state of the direction indicator switch **200**. The second signal from the top shows the voltage at the second terminal **102**. The third signal from the top shows the voltage at the third terminal **103**, or the voltage of the capacitor **600**. The fourth signal from the top shows the charge current and discharge current. The direction indicator circuit begins to operate when the direction indicator switch **200** is closed **1030**.

Starting from this time **1030**, the switch **110** is firstly still open and the capacitor is charged with a high current during the starting phase until an upper threshold is reached. Then, the direction indicator circuit periodically passes through the on state and the off state. The capacitor is charged with a charge current during the off state. The duration of the off state is determined by the charging of the capacitor. During the on state the capacitor is discharged with a discharge current. The duration of the on state is determined by the discharging of the capacitor. This has the advantage that only relatively small currents flow during the off state and during the on state. A further advantage is that no charge pulses give rise to large electromagnetic emissions. This has the further advantage that both the duration of the on state and the duration of the off state are determined by currents which differ only in terms of their sign.

FIG. 5 shows a direction indicator circuit. The direction indicator circuit **100** has a first terminal **101**, a second terminal **102** and a third terminal **103**. A capacitor **600** is connected to the second terminal **102** and third terminal **103**. The direction indicator circuit has a first circuit block **710**, a first further circuit block, a first power source **730** and a current mirror **751**. These components are coupled, for their supply, to the second terminal **102** and third terminal **103**. The first circuit block **710** has a voltage divider and a bandgap circuit which is designed to measure the voltage of the capacitor **600**. The voltage divider and the bandgap circuit of the first circuit block **710** discharge the capacitor with a low current. The voltage divider and the bandgap circuit have a temperature dependence. The temperature coefficient of the first circuit block **710** can be negative, for example. The current of the first power source **730** can be derived, for example, from the bandgap circuit. The current of the first power source **730** can be derived in such a way that the current does not have a

6

temperature dependence. The current then has a temperature coefficient of 0. The first further circuit block **720** can be supplied using a current mirror **751**. The first further circuit block **720** therefore also has a temperature coefficient of 0. The current of the first power source **730** and the current flowing through the first further circuit block **720** can be selected in such a way that the entire current of the direction indicator circuit **100** has a temperature coefficient which is negligible.

FIG. 6 shows an embodiment of a direction indicator circuit **100**. This embodiment of the direction indicator circuit **100** differs from the direction indicator circuit in FIG. 5 in that the embodiment of the direction indicator circuit **100** has a second power source **731**, a second further circuit block **721** and a further current mirror **752**. The current of the second power source **731** may be derived in such a way that the current has a positive temperature dependence. The current then has a positive temperature coefficient. The current of the second power source **731** can be selected in such a way that the current of the second power source **731** is essentially as high as the current through the first circuit block **710**. As a result, the negative temperature coefficient of the current through the first circuit block **710** can be compensated, with the result that the temperature coefficient of both currents is essentially 0. This has the particular advantage that a particularly large value no longer has to be selected for the current of the first power source **730**. The current of the first power source **730** and of the second power source **731** can then be selected within the customary scope of, for example,  $0.1$  to  $10\ \mu\text{A}$ . The total power consumption of this embodiment can be in the range from approximately  $40$  to  $100\ \mu\text{A}$ . The power consumption of this embodiment is therefore significantly smaller than the power consumption of the direction indicator circuit **100** shown in FIG. 5.

FIG. 7 shows the qualitative effect of the superimposition of in each case one negative, one neutral and one positive temperature coefficient on the currents of the circuit blocks.

FIG. 8 shows a further embodiment of a direction indicator circuit **100**. The embodiment in FIG. 8 differs from the embodiment in FIG. 6 in that the current with a positive temperature coefficient is not selected by means of the second power source **731** but rather is formed by a difference-forming means in the direction indicator circuit **100** in such a way that the current is substantially compensated with the negative temperature coefficient.

FIG. 9 shows a further embodiment of a direction indicator circuit **100**, and

FIG. 10 shows signal profiles.

Various embodiments provide a direction indicator circuit for which a more cost-effective capacitor for supplying power is sufficient.

A simple semiconductor circuit is used as the direction indicator circuit, which semiconductor circuit only has to have three terminals, one terminal for connecting a supply voltage, one terminal for connecting a vehicle ground or a ground terminal of the vehicle. A third terminal serves to connect a capacitor. This capacitor fulfils two functions: on the one hand this capacitor serves to supply voltage to the direction indicator circuit, and on the other hand it serves as a capacitor for implementing an oscillator using the direction indicator circuit. Direction indicator circuits have a high side switch which in an on state provides a current for the lighting means. During the on state, the voltages within the direction indicator circuit such as, for example, the gate voltage of the high side switch, are higher than the supply voltage. The connected capacitor therefore performs the function of a boot strap capacitor. During the on state, the connected capacitor is

discharged. During an off state, the voltages within the direction indicator circuit, such as, for example, the gate voltage of the high side switch, are lower than the supply voltage. During the off state, the connected capacitor is charged. By using these charging and discharging times it is possible to define the frequency of the direction indicator circuit and of the direction indicator device per se. The direction indicator circuit is activated by the direction indicator switch. If the direction indicator switch is closed or at a low impedance, a flow of current through the direction indicator circuit and through the direction indicator lighting means becomes possible. The direction indicator circuit firstly charges the capacitor. As soon as the capacitor is charged, the direction indicator circuit starts. After the start of the direction indicator circuit, it closes its internal switch and therefore permits a flow of current through the lighting means of the direction indicator. The direction indicator circuit opens and closes the internal switch with a frequency of 1.5 Hz.

If, for example in order to save costs, the size of the capacitor is reduced, it is possible, for example, to reduce the power consumption of the direction indicator circuit. In this context, the discharge current should be constant over a wide temperature range so that the direction indicator frequency also remains constant over this wide temperature range. So that the direction indicator frequency remains constant plotted against the temperature, the capacitor should be discharged with a current which is constant over the temperature range since the direction indicator frequency is defined, inter alia, by the size of the capacitor, the discharge current and an upper and a lower threshold. Furthermore, the capacitor should also be charged with a current which is constant over the temperature range since the direction indicator frequency is defined, inter alia, by the size of the capacitor, the charge current and a lower and an upper threshold. The frequency can be defined by the size of the capacitor, the discharge current, the charge current and an upper and a lower threshold. If a bandgap circuit is used in the direction indicator circuit to provide a temperature-constant voltage and a voltage divider is used to measure the thresholds or other voltages, there is at least one circuit which has a temperature dependence. The direction indicator circuit can have, for discharging the capacitor, a temperature-stable power source whose current is greater than the power consumption of the rest of the direction indicator circuit. This measure allows the temperature dependence of the total power consumption to be ignored. If, for example, the direction indicator circuit has a power consumption of 10  $\mu\text{A}$  and if the current of the temperature-stable power source is set to 1 mA, the resulting error is approximately 1%. In the case of a discharge current of 1 mA and a direction indicator frequency of 1.5 Hz, the capacitor requires a capacitance of approximately 220  $\mu\text{F}$ .

The direction indicator circuit for controlling a direction indicator in a vehicle includes a first terminal for connecting to a supply voltage terminal, a second terminal for connecting to a direction indicator switch and a lighting means, and a third terminal for connecting to a capacitor. The direction indicator circuit is designed to provide the lighting means with a current during an on state and with no current during an off state. The duration of the on state and the duration of the off state are determined by a voltage at the capacitor (600). The direction indicator circuit has a first and a second circuit, wherein the capacitor provides a supply voltage for the first and second circuits during the on state. The current which flows through the first circuit has a negative temperature coefficient, and the current which flows through the second circuit has a positive temperature coefficient.

The capacitor can be discharged essentially constantly during the on state and can be charged essentially constantly during the off state.

The sum of the currents which flow through the first and second circuits has a temperature coefficient of essentially 0.

A regulating circuit can regulate the current which flows through the second circuit in such a way that the sum of the currents which flow through the first and second circuits has a temperature coefficient of essentially 0.

The currents which flow through the first and second circuits can be defined in such a way that the sum of these currents has a temperature coefficient of essentially 0.

If the capacitor is discharged to such an extent that the direction indicator circuit is operational, the direction indicator circuit cannot readily determine, due to its simple and cost-effective design, whether the switch is open or closed. The direction indicator circuit instead behaves as if the switch were closed, since under normal circumstances this constitutes a requirement for operation and therefore a requirement for a charged capacitor. An operational voltage is made available to the direction indicator circuit by means of the charged capacitor, with the result that the direction indicator circuit is operational. If the direction indicator circuit is operational, the internal switch is opened and closed periodically. During the on state, the switch is closed and the external capacitor is discharged. The duration of the on state and the duration of the off state are determined essentially by the size of the external capacitor. During the on state, the switch is closed, with the result that a current can flow through the lighting means. The voltage at the capacitor is higher than the supply voltage, with the result that the direction indicator circuit is supplied by the capacitor. The direction indicator circuit is configured in such a way that the capacitor is discharged by a constant current. If the current is constant during the discharging, the duration of the on state is also constant if the on state starts at an upper threshold and ends at a lower threshold. During the off state, the switch is opened, with the result that no current can flow through the lighting means. The voltage at the capacitor is lower than the supply voltage, with the result that the capacitor can be charged again. The direction indicator circuit is supplied by the supply voltage terminal. The direction indicator circuit is configured in such a way that the capacitor is then charged by means of a constant current. If the current is constant during the charging, the duration of the off state is also constant if the off state starts at a lower threshold and ends at an upper threshold. A particular advantage obtained by means of this procedure is that no hard edges occur since only a soft transition from a charging process to a discharging process occurs. If, for example, the charge current and discharge current are of equal magnitude and have a value of 100  $\mu\text{A}$ , the change in current is merely 200  $\mu\text{A}$ . If, for example, the capacitor is charged with pulses, the changes in current are significantly larger and therefore the electromagnetic emission is also substantially larger. A further particular advantage obtained is that both the on state and the off state are implemented in a similar way and charging pulses do not disrupt the determination of the duration either in the on state or in the off state.

While the invention has been particularly shown and described with reference to specific embodiments, it should be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention as defined by the appended claims. The scope of the invention is thus indicated by the appended claims and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced.

9

What is claimed is:

1. A direction indicator circuit for controlling a direction indicator in a vehicle, the direction indicator circuit comprising:

a first terminal for connecting to a supply voltage terminal; 5  
a second terminal for connecting to a direction indicator switch and a lighting means;

a third terminal for connecting to a capacitor;

wherein the direction indicator circuit is designed to provide the lighting means with a current during an on state 10  
and with no current during an off state,

wherein the duration of the on state and the duration of the off state are determined by a voltage at the capacitor;

wherein the direction indicator circuit has a first and a second circuit, 15

wherein the capacitor provides the supply voltage for the first and second circuits during the on state;

wherein the current which flows through the first circuit has a negative temperature coefficient, and

10

the current which flows through the second circuit has a positive temperature coefficient,

wherein the second circuit comprises a power source, wherein the current of said power source is derived in such a way that the current has a positive temperature dependence.

2. The direction indicator circuit of claim 1, wherein the sum of the currents which flow through the first and second circuits has a temperature coefficient of essentially 0.

3. The direction indicator circuit of claim 1, wherein a regulating circuit regulates the current which flows through the second circuit in such a way that the sum of the currents which flow through the first and second circuits has a temperature coefficient of essentially 0.

4. The direction indicator circuit of claim 1, wherein the currents which flow through the first and second circuits are defined in such a way that the sum of these currents has a temperature coefficient of essentially 0.

\* \* \* \* \*